# IEEE P802.15
# Wireless Personal Area Networks

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| Project | IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs) | |
| Title | **AV PHY LB43 suggested resolutions** | |
| Date Submitted | [5 August, 2008 | |
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| Re: | [] | |
| Abstract | [Suggested comment resolutions from LB43 for the AV PHY.] | |
| Purpose | [To assist in comment resolution.] | |
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# 1. AV PHY issues related to MAC

## 1.1 Extended MAC header (CID 29)

Comment:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 29 | 7.2.10.1 | 20 | 40 | T | N | Exteneded MAC header | Please add text to clause 8 (MAC functional description) to describe the function of the extended MAC header. |

Suggested resolution – Accept in principle: Add to 7.2.10.1 "The Extended MAC header is used to describe the contents of an AV aggregated frame, which typically is used to transport uncompressed audio and video."

## 1.2 Normal, composite frame (CID 30)

Comment:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 30 | 7.2.10.1.1 | 21 | 29 | T | N | Normal and Composite Frames Classes | What is a Normal frame? What is a Composite frame? There is no explanation of these terms and the reader is left guessing. |

Suggested resolution – Accept in principle: change "normal" to be "regular" and "composite" to be "AV aggregated" and add to the section "Regular frames have a single payload field without MAC level aggregation while AV aggregated frames have one or more subframes as a part of the frame."

## 1.3 AV information in PHY and MAC header

Comment:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 121 | 7.2.10.1.4 | 23 | | T | Y | Move video header to a FCSL | The level of detail in the video header is not consistent with the level of detail that should be associated with the MAC layer. Information such as the video frame number, Horizontal position, Vertical position, progressive scan, interlaced scan are not MAC level parameters. The video header should be assembled in a video FCSL layer and passed down to the MAC as a MSDU. If it is necessary to keep the video header with the composite frame containing video sub-frames then that composite frame should be assembled in the video FCSL and passed down to the MAC as a MSDU. |

Suggested resolution – Reject: The video information is carried in the MAC header because its delivery is more reliable than that of the sub-frames. Because the video is uncompressed, even corrupted sub-frames can be used to recreate an adequate video image, if the position of the pixels and related information is correctly delivered. This particularly important for UEP implementations that provide correct msbs but have lsbs with errors. For compressed video or data streams, this information is not as useful and so it can be carred in the MSDU.

## 1.4 AV aggregated frame format (CID 142, CID 569, CID 570, CID 571, CID 572, CID 573, CID 574, CID 575, CID 576, CID 577)

Comment:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 142 | 7.2.10 | 20 | 31 | T | Y | There is AV aggregated frame body format defined separately from the Low Latency and Standard aggregation. It is not clear if it applies to one of the defined aggregation schemes or not. | Provide explanation. Unify the aggregation schemes to be usable for any PHY |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 569 | 7.2.10 | 20 | 28-38 | T | Y | Is the "AV aggregated frame format" intended to be used only with the A/V OFDM PHY? | Please clarify. The spec would be far simpler if the HSI OFDM and A/V OFDM modes were merged. |
| 570 | 7.2.10.1 | 20, 21 | 39-48 | T | Y | Is the "Extended MAC header" intended to be used only with the A/V OFDM PHY? | Please clarify. The spec would be far simpler if the HSI OFDM and A/V OFDM modes were merged. |
| 571 | 7.2.10.1.1 | 21, 22 | 15-54 | T | Y | Is the "Extended control header" intended to be used only with the A/V OFDM PHY? | Please clarify. The spec would be far simpler if the HSI OFDM and A/V OFDM modes were merged. |
| 572 | 7.2.10.1.2 | 22 | 6-41 | T | Y | Is the "MAC extension header" intended to be used only with the A/V OFDM PHY? | Please clarify. The spec would be far simpler if the HSI OFDM and A/V OFDM modes were merged. |
| 573 | 7.2.10.1.3 | 22, 23 | 43-54 | T | Y | Is the "Security header" intended to be used only with the A/V OFDM PHY? | Please clarify. The spec would be far simpler if the HSI OFDM and A/V OFDM modes were merged. |
| 574 | 7.2.10.1.4 | 23, 24 | 21-54 | T | Y | Is the "Video header" intended to be used only with the A/V OFDM PHY? | Please clarify. The spec would be far simpler if the HSI OFDM and A/V OFDM modes were merged. |
| 575 | 7.2.10.2 | 24, 25 | 13-54 | T | Y | Is the "subframe format" defined in this subclause intended to be used only with the A/V OFDM PHY? | Please clarify. The spec would be far simpler if the HSI OFDM and A/V OFDM modes were merged. |
| 576 | 7.2.10.3 | 25, 26 | 45-54 | T | Y | Is the "composite" frame defined in this subclause intended to be used only with the A/V OFDM PHY? | Please clarify. The spec would be far simpler if the HSI OFDM and A/V OFDM modes were merged. |
| 577 | 7.2.10.4 | 26 | 3-21 | T | Y | Is the "normal" frame defined in this subclause intended to be used only with the A/V OFDM PHY? | Please clarify. The spec would be far simpler if the HSI OFDM and A/V OFDM modes were merged. |

Suggested resolution – Accept in principle: Add text to the beginning of 7.2.10, "The AV aggregated frame format is optimized to carry uncompressed audio and video in an efficient manner. The AV aggregated frame format is used instead of the standard aggregation or low latency aggregation formats."

## 1.5 Long and short preamble (CID 322)

Comment:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 322 | 12.4.3 | 144 | 27 | T | N | The first Omni LRP packet in a CTA shall be sent using the short Omni LRP preamble. Subsequent frames shall use the long Omni LRP preamble …The beacon frame shall use the long Omni LRP preamble | It is not clear what is the rule for preamble type for multiple bursts separated by SIFS + ACK +SIFS. need clarification |

Suggested resolution – Accept in principle: Change "Subsequent frames shall use …" to be "Subsequent LRP frames sent in a CTA shall use …"

## 1.6 Different defintions of headers for AV PHY (CID 323 and CID 324)

Comment:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 323 | 7.2.10.1.2 | 22 | 6 | T | N | do not understand the different definitions of headers for AV PHY in 2 sections | need clarification |
| 324 | 12.4.3.8 | 148 | 47 | T | N | do not understand the different definitions of headers for AV PHY in 2 sections | need clarification |

Suggested resolution – Accept in principle: The Directional LRP header is a PHY header used for LRP frames. The subframe format is a MAC header used for the subframes that are part of the payload of a PHY frame. LRP frames do not use the composite format, so the subframe header is not used for LRP frames.

### 1.7 Use of Frame type field in Extended Control Header field (CID 325)

Comment:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 325 | 7.2.10.1 | 21 | 51 | T | N | Do not understand the different use of Frame type in Extended control header and type field in MAC Extension Header | need clarification |

Suggested resolution – Accept in principle: The Frame Type field in the Extended Control Header field is used for "Normal" frame types which have only one sub-frame. The Type field in the MAC Extension Header field is used for "Composite " frame types which have one or more sub-frames that may be of different types. The MAC Extension Header field is not used for "Normal" frame types to save space in LRP frames. In 7.2.10.1 change "… in other frames. Valid values …" to be "… in other frames. AV aggregated frames use the Type field in the MAC Extension Header field while the Omni-ACK and Beacon frames don't require the Frame Type field. Valid values …"

## 2. AV OFDM specific comments

### 2.1 CCA time for HR PHY (CID 92)

Comment:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 92 | 12.4.1.2.6 | 130 | 22 | T | Y | CCA detect time | This clause indicates that CCA detection is not supported for the HRP AV PHY, but yet in clause 12.4.1.5 it is indicated that the AV PHY shall support the use of the CAP. There are various reasons the HRP AV PHY needs to do a CCA. |

Suggested resolution – Accept in principle: All contention for the AV PHY is done with the LRP, not the HRP. Add text to 12.1.4.2.6 at the end of the last sentence ", because only the LRP is used in CPs."

### 2.2 UEP multiplexer description (CID 93 and CID 94)

Comment:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 93 | 12.4.2.10.2 | 137 | 12 | T | N | Clarification figure needed. | The text on the UEP coding data multiplexer is confusing and a clarification drawing would be useful. |
| 94 | 12.4.2.10.3 | 139 | 8 | T | N | Clarification figure needed. | The text on the UEP mapping data multiplexer is confusing and a clarification drawing would be useful. |

Suggested resolution: Need to discuss with the commenter to see what kind of figure or modifications to existing figures would assist in understanding the multiplexer.

### 2.3 OQPSK in preamble (CID 97)

Comment:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 97 | 12.4.3.3 | 146 | 18 | T | N | Wham … out of the blue we are told the AV PHY uses OQPSK for the preamble. What else is OQPSK used for, before switching to OFDM? | Table 153 (LRP modulation parameters) doesn't mention OQPSK. A paragraph should be added in regards to how OQPSK is used for the LRP (and perhaps in the HRP?). |

Suggested resolution – Accept in principle: The OQPSK modulation is only used for the preamble, not for data modulation, and so it isn't mentioned in Table 153. To clarify this, change the first sentence of the sec-

ond paragraph from “The OQPSK sequence is created …” to be “The OQPSK sequence used in the LRP preamble is created …”

## 2.4 Switch from OQPSK to OFDM in Figure 209 (CID 99 and CID 101)

Comment:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 99 | 12.4.3.4 | 147 | 8 | T | N | Figure 206: Modification of Figure 206 | Please modify Figure 206 to indicate where we switch from OQPSK to OFDM. |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 101 | 12.4.3.5 | 147 | 46 | T | N | Figure 207: Modification of Figure 207 | Please modify Figure 206 to indicate where we switch from OQPSK to OFDM. |

Suggested resolution – Reject: The switch between OQPSK and OFDM is adequately described in the text that follows the figure.

## 2.5 TX antenna switching (CID 100 and CID 102)

Comment:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 100 | 12.4.3.4 | 147 | 33 | T | N | Clarification needed on the text | We are given a listing of numbers and told they "respectively" go with the fields in Figure 206. "Respective" is a matter of interpretation and we are asking for trouble. Please explicitly indicate which sample number goes with which field. |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 102 | 12.4.3.5 | 148 | 11 | T | N | Clarification needed on the text | We are given a listing of numbers and told they "respectively" go with the fields in Figure 207. "Respective" is a matter of interpretation and we are asking for trouble. Please explicitly indicate which sample number goes with which field. |

Suggested resolution – Accept in principle: Change the text into a table that lists the field name and the number of samples for the antenna pattern switching.

## 2.6 Confusing sentence (CID 105)

Comment:

| | | | | | | |
|---|---|---|---|---|---|---|
| 12.4.3.8 | 150 | 13 | T | N | Confusing incoherent sentence | I'd make a suggestion on what to do but I don't understand it. The sentence begins "When performing convolutional ... ". |

Suggested resolution – Accept in principle: Change “When performing convolutional … the tail-biting code is used.” to be “The number of encoded bits in the Directional LRP Payload field determines if the standard code with tail bits or the tail-biting code is used on the field.”

## 2.7 Beam forming for AV PHY (CID 112, CID 138, CID 147, CID 235)

Comment:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 112 | 13.3 | 164 | 45 | T | Y | Beam Forming for the AV PHY | It appears the techniques of section 13 are not applicable to the AV PHY, so how does the AV PHY do beam forming and antenna training? AV PHY beam forming and antenna training text needs to be added to the document. |
| 138 | 13.3 | 165 | 27 | T | Y | Beam Forming protocol is defined for the SC and HSI-OFDM PHY only. What is the beamforming protocol for the AV PHY? | Define beamforming protocol for the AV PHY |
| 147 | 13.3 | 165 | 27 | T | Y | Beam Forming is somewhat defined for the SC and HSI-OFDM PHY only. What is the beamforming protocol for the AV PHY? | Define beamforming protocol for the AV PHY |
| 235 | 13.3 | 164 | 45 | T | Y | Beam Forming for the AV PHY | AV PHY beam forming and antenna training text needs to be added to the document. |

Suggested resolution – Accept in principle: Change "the SC or HSI-OFDM bit stream" to be "the bit-stream" and change "to the burst size in SC (K = 256) or to the number of used carriers in HSI-OFDM (K = 352)." to be "to the burst size in the SC PHY or to the number of used subcarriers in the HSI or AV PHY."

## 2.8 RS with convolutional coding vs. LDPC with RX coding (CID 283, CID 481)

Comment:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 283 | 12.4.2.8 | 134 | 42 | T | Y | Whats the reason to use convolutional coding concutenated with RS and not LDPC concutenated with RS | |
| 481 | 12.4.2.8 | 134 | 42 | T | Y | why CC with RS and not LDPC with RS? | |

Suggested resolution – Accept in principle: The RS code is needed to improve the performance of the convolutional code. However, the LDPC code does not require an outer encoder. No change required.

# 3. Minor technical comments

## 3.1 Q-omni (CID 48)

Comment: Add Q-omni to acronyms

Suggested resolution – Accept in principle: Reformat the figures that use Q-omni to match the format used in the draft and change Q-omni to quasi-omni throughout the draft.

## 3.2 CP usage (CID 58 and CID 95)

Comment: Conflict between usages of CP in the draft.

Suggested resolution – Accept in principle: Change CP (where it refers to the cyclic prefix) and cyclic prefix to be GI and guard interval, respectively, to avoid confusion with contention periods (CPs) that is already defined in the 802.15.3b. Alternatively, change CP (where it refers to cyclic prefix) to be cyclic prefix.

### 3.3 Overlap of ST and ST_ primitives (CID 117)

Comment:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 117 | Table A.2 | 179 | | T | N | Notation problem | There is a possible confusion in regards to the use of the abbreviation ST. ST was defined in section 4 as "sector training", yet here it is used to indicate "stream"???? Please clean up by using unique notation. |

Suggested resolution – Accept in principle: Change “ST_” to “STREAM_” in the primitives in this sub-clause.

### 3.4 Antenna connector (CID 587)

Comment:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 587 | 12.1.2 | 59 | 44-46 | T | Y | If there is no antenna connector, how can the antenna gain be determined so that it can be compensated? | Is it important? Needs thought. |

Suggested resolution – Accept in principle: In order to allow innovation in antenna design, different antenna gains are anticipated for this standard. In particular, some antenna designs may make it difficult, if not impossible, to perform an “antenna connector” measurement. However, with simulations and analysis, a manufacturer can estimate the antenna gain and to calculate the power at the antenna to radio interface. No change required.

## 4. Empty bits in Figure 42a (CID 32, CID 385, CID 493, CID 579)

Comment:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 32 | 7.4.7 | 31 | 16 | T | N | Figure 42a: Empty bits in the field format | Bits 22 to 17 are unspecified. Please indicate the use of these bits. |
| 385 | 4.21 | 31 | 3 | T | Y | In Figure 42a, bit fields b17-b22 are undefined. What are they used for? | Add labels to explain how these fields are used or mark them as Reserved. |
| 493 | 7.4.22 | 31 | Figur | T | Y | bit 17 to bit 22 usage are not defined and there are two PET bits | define it |
| 579 | 7.4.2.1 | 31 | 16-17 | T | Y | In figure 42a, what are b22..17? They are neither defined nor reserved. | Please define the bits or indicate that they are reserved! |

Suggested resolution – Accept in principle: This is a typo, the extra bits are not needed. Replace Figure 42a with below.

| **bits: 2** | **2** | **1** | **3** | **4** | **4** |
|---|---|---|---|---|---|
| Number RX quasi-omni directions | Number TX quasi-omni directions | PET | Antenna type | Number RX sectors | Number TX sectors |

**Figure 42a—Beam forming capabilities field format**

## 5. EVM calculation

The error vector magnitude (EVM) requirement is used to ensure a certain quality transmitted signal. In particular, the EVM of the transmitter creates a limit to the BER that can be achieved, i.e., a BER floor. When

the EVM is impaired due to random events (TX noise, clock jitter, LO phase noise, etc.), there is nothing that the receiver can do to improve the signal. Thus, the first number required for EVM is the desired BER floor. In the case of AV OFDM, this is $10^{-7}$ (so that $10^{-9}$ pixel error rate can be obtained with a minimal number of retries). Next, the theoretical SNR required for each mode needs to be calculated or simulated. Then, this number is increased by the expected implementation loss, channel impairement due to multipath (not all of the multipath can be removed) and additional margin (typically 2-3 dB so TX EVM only contributes half of the BER floor). The result is the EVM requirement. For the AV PHY, this is summarized in Table 1

**Table 1—EVM calculations for AV PHY to support 10-7 BER**

| Mode | Required SNR | Implementation loss | Multipath | Margin | EVM |
|---|---|---|---|---|---|
| 0 | 1 dB | 1 dB | 2 dB | 3 dB | 7 dB |
| 1 | 6 dB | 2 dB | 3 dB | 3 dB | 14 dB |
| 2 | 12 dB | 3 dB | 3 dB | 3 dB | 21 dB |

## 6. Number of PHYs

CIDs 8, 18, 19, 20, 21, 126, 133, 149, 151, 163, 227, 278, 282, 301, 369, 370, 371, 376, 379, 380, 418, 435, 440, 477, 487, 554, 590, 634, 637

Summary of elected suggested resolutions:

Remove subclause 12.3 and any references,
Delete either section 12.3 or 12.4, preference is 12.3,
use same tone spacing,
use same interleaver
Merge OFDMs, retain LRP
Merge OFDMs
Reduce number of PHYs to less than 3
Use same preamble
Remove any two of the sections 12.2, 12.3 and 12.4.

Suggested resolution – The HSI PHY design is optimized to provide bi-directional, low latency data connectivity while the AV PHY design is optimized to provide high quality, uncompressed, lossless, high-definition audio and video streaming content.

## 7. Supported channels in Clause 5 (CID 9)

Comment:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 9 | 5.5.1 | 4 | 21 | T | Y | The text "In addition, a compliant device is not required to support more than one channel." is ambiguous and may lead to non-interoperable implementations. Here is the way I interpreted the text when I read it: Product A operates only on channel A, Product B operates only on channle B. Both products are compliant with the text, yet thy cannot interoperate. Perhaps the ambiguity is resolved elsewhere in the document or I don't fully understand the context in which this clause is to be applied. | Resolve the ambiguity--as an example, I would change the text to read "In addition, a compliant device is not required to support more than one channel, specifically channel A." Where channel A is defined elsewhere in the document. |

Suggested resolution – (pending)